Generation IV Roadmap: Technical Working Group Progress

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ICONE-10
April 16, 2002

Topics

- ***Technical Working Group (TWG) charter***
- ***TWG progress to date***
  - ***Identification of candidate systems (concepts)***
  - ***Evaluation of concepts against the goals***
- ***Overview of evaluation results***
- ***Future TWG activities***
  - ***Development of Roadmap R&D plan***

TWG Charter

- ***Identify candidate Gen IV systems (concepts)***
- ***Evaluate system performance potential***
- ***Analyze technology gaps and R&D challenge for high-potential concepts***
- ***Develop R&D plan for concepts that best meet the Gen IV goals***

Concept Identification

- ***TWGs have identified and analyzed ~100 system ideas***
  - ***Request for information issued April 2001***
  - ***Extensive survey of options***

- ***Evaluations required specification of entire system***

- ***Fuel cycle choice based in part on Fuel Cycle Crosscut Group studies***
  - ***Achievable gains toward sustainability goals with different system options***
  - ***Potential for fuel cycle symbiosis***
    - ***Different reactors may fulfill specific actinide management functions***

Concept Evaluation

- ***Evaluations conducted in two phases***
  - ***Screening for potential: qualitative, designed to narrow options***
  - ***Final screening: semi-quantitative, designed to support selection***

- ***Similar concepts grouped into "concept sets"***

- ***Screening for potential performed using criteria developed by Evaluation Methodology Group (EMG)***
  - ***For each criterion, TWGs judged performance potential relative to ALWR once-through reference system***
  - ***Criteria ratings could range from "much better" to "much worse"***

Concept Sets

Water Cooled Systems

- *Advanced Loop PWRs*
- *Integrated Primary System Reactors*
- *Pressure Tube Reactors*
- *Simplified BWRs*
- *High Conversion Cores*
- *Supercritical Water Reactors (Thermal and Fast)*
- *Pebble Fuel Reactors*

Gas Cooled Systems

- *Pebble Bed Reactors*
- *Prismatic Modular Reactors*
- *Very High Temperature Reactors*
- *Fast-spectrum Gas Reactors*

Concept Sets, cont'd

Liquid Metal Cooled Systems

Sodium LMR, MOX fuel
Sodium LMR, Metal fuel
Lead or Lead-Bismuth LMRs
Small, Transportable LMRs
Novel Steam Generator Concepts

Non-Classical Reactor Systems

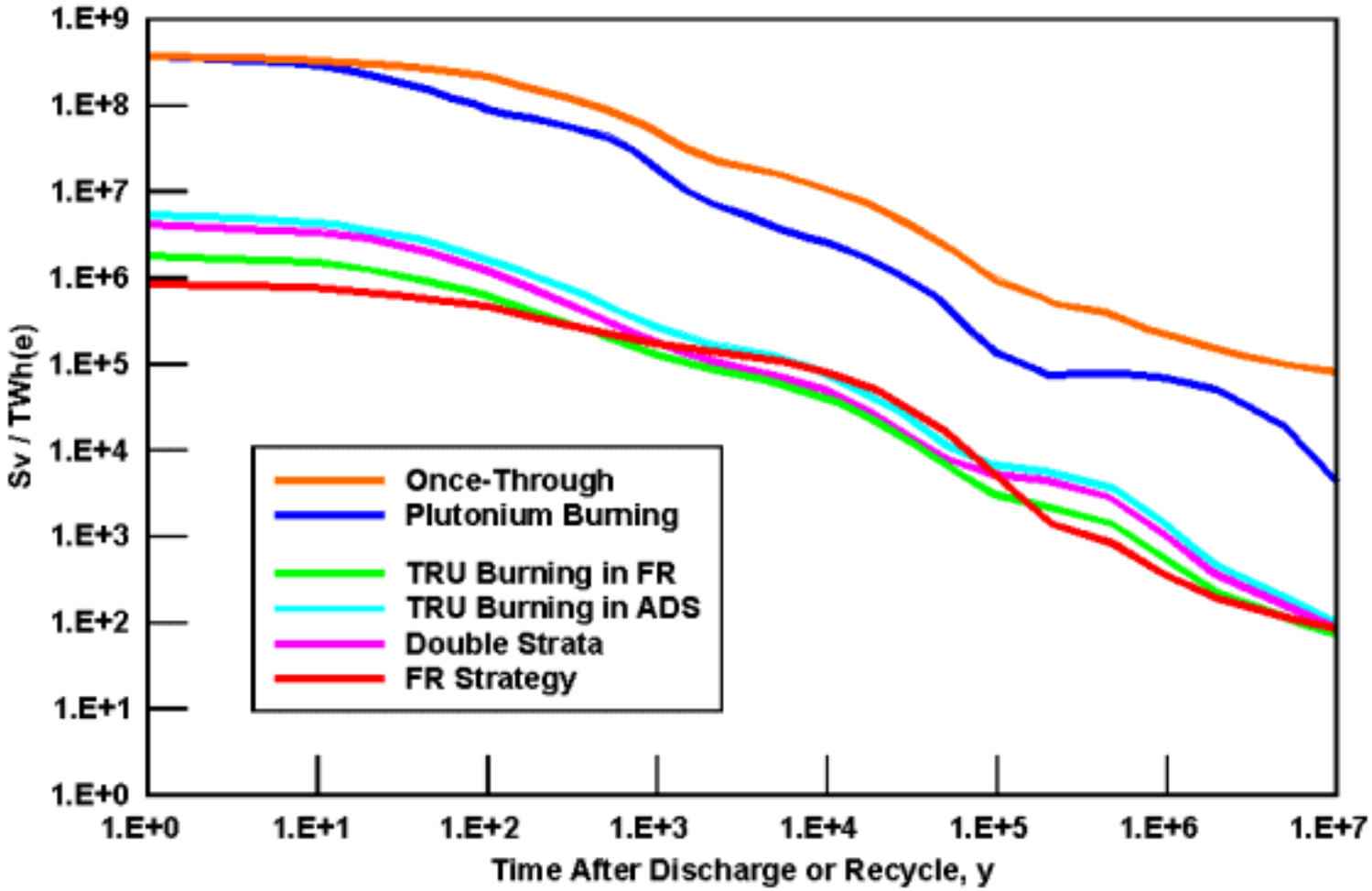
Non-conventional Coolant Reactors
Liquid Core Reactors
Gas/Vapor Core Reactors
Non-convection Cooled Reactors
Direct Energy Conversion Reactors

Fuel Cycle Options

REACTOR			FUEL CYCLE: Once Through	Partial Fissile Recycle	Full Fissile Recycle	Full Actinide Recycle
Thermal	Solid Fuel	Water Cooled	U, Th	U, Th	Th	Th
		Gas Cooled	U, Th	U, Th	Th	Th
		Molten Salt Cooled	U, Th	U, Th	Th	Th
	Fluid Fuel	Liquid Core			U, Th	U, Th
		Gas/Vapor Core			U	U
Epithermal/ Fast	Solid Fuel	Water Cooled			U, Th	U, Th
Fast	Solid Fuel	Gas Cooled			U, Th	U, Th
		Liquid Metal Cooled			U, Th	U, Th

Fertile material: • reference, • alternate, • option

Impact of Recycle on Waste Toxicity

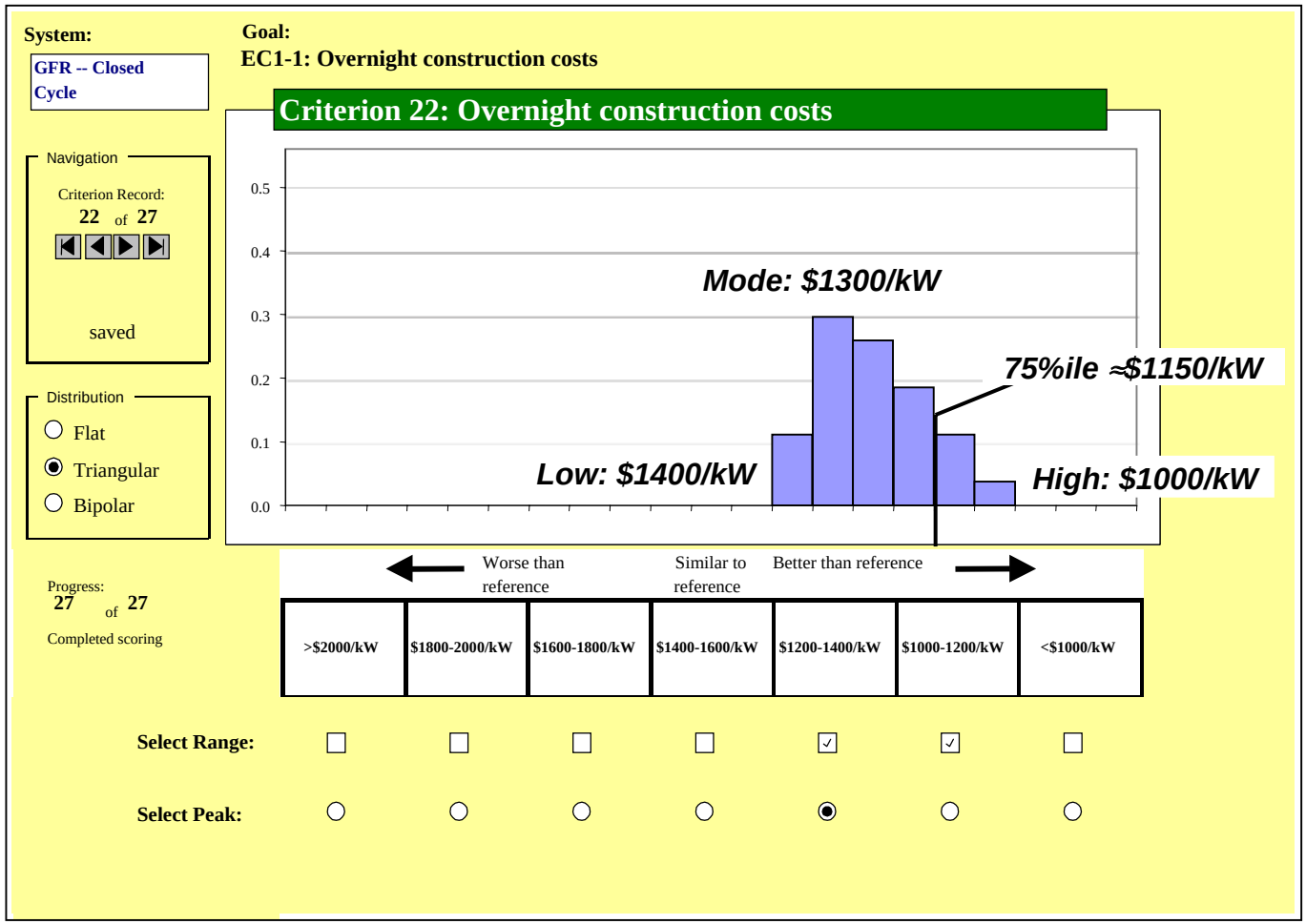


System Concepts

Reactor System	Fuel Cycle
Integral Primary System Reactors	LEU Once-through
Simplified Boiling Water Reactors	LEU Once-through
CANDU Next Generation	LEU Once-through, DUPIC
Supercritical Water Reactors – Thermal Spectrum	LEU Once-through
Supercritical Water Reactors – Fast Spectrum	Full actinide recycle
High Conversion Boiling Water Reactors	Full actinide recycle
Pebble Bed Modular Reactors	LEU Once-through
Prismatic Modular Reactors	LEU Once-through
Very High Temperature Reactors	LEU Once-through
Generic High Temperature Gas Reactors – Closed Cycle	Full actinide recycle (Th)
Gas Fast Reactor	Full actinide recycle
Sodium cooled, MOX fuel, advanced aqueous process	Full actinide recycle
Sodium cooled, metal fuel, pyroprocess	Full actinide recycle
Pb/Pb-Bi cooled modular reactors	Full actinide recycle
Transportable Pb/Pb-Bi cooled reactors	Full actinide recycle
Liquid Core (Molten Salt) Reactors	Full actinide recycle (U,Th)
Vapor Core Reactors	Full actinide recycle
Molten Salt Cooled Prismatic Fuel Reactor	LEU Once-through

Final Screening Evaluation

- ***TWGs evaluated high-potential concepts using "Final Screening" methodology***



Final Screening Evaluation, cont'd

- ***Evaluations were reviewed for consistency by Crosscut Working Groups and the Roadmap Integration Team (RIT)***
- ***Performance distributions for each goal obtained by aggregation***
  - ***Using specified criteria weights***
- ***Numerical results inform the selection process, but do not yield the selections***

Highlights of System Strengths

- ***Sustainability***
  - ***Closed cycle fast-spectrum systems***
    - » ***Na and Pb/Pb-Bi liquid metal concepts***
    - » ***Fast gas-cooled concepts***

- ***Safety and Reliability***
  - ***Thermal-spectrum gas-cooled concepts***

- ***Economics***
  - ***Water- and gas-cooled concepts***
    - » ***Life cycle cost points to large/monolithic plants***
    - » ***Investment risk points to small or modular plants***

- ***Hydrogen production and high-temperature applications***
  - ***Very high temperature gas-cooled reactor***
  - ***Molten salt-cooled prismatic reactor***
  - ***Pb/Pb-bi liquid metal concepts***

Current and Future Activities

- ***Roadmap focus is advancing from concept evaluation to R&D plan development***
- ***TWGs are defining concept-specific technology gaps and R&D***
- ***Crosscut Working Groups will integrate concept-specific R&D and recommend crosscutting R&D***
  - ***Fuel cycle***
  - ***Fuels and materials***
  - ***Energy Products***
  - ***Risk and safety***
  - ***Economics***

Backup Slides

Preliminary View of System Applications and Availability